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Job Losses and the Middle Class: Canada and the USA, and the Possible Role of ICT

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9.1 Introduction

Since 2000, three telecoms related issues have arisen in prominence for economists, as well as politicians—first, the productivity decline since at least the mid 2000s—where is the vaunted productivity impact of Information and Communications Technology (ICT)? Second, is an attempt to understand "polarization"—a decline in jobs and wages in the "middle" of the income distribution? Third, is the growth of ICT the cause of this polarization?

Since 2005 productivity growth in the west is not growing as fast as in the previous ten years. This poor performance has negatively impacted economic growth since *productivity* is one of the three sources of long-term economic growth, the other two being the *rate of growth of labor* (the rate of growth of population and the participation rate or the proportion employed equals the percentage employed) and the *growth rate of capital*. Of these three sources, productivity is the one most examined, discussed, and written about as it appears to be the one factor that countries can affect in the medium term. Thus, the preoccupation with productivity is because it appears to be something more controllable than long-run trends in population growth or capital accumulation.

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At the same time as the productivity slowdown, there appears to be a rise in income inequality across many western nations, particularly the USA and Israel. This rise in inequality was brought to prominence with Thomas Piketty's best-selling book, *Capital in the Twenty First Century*.[1]

The data, at least for the USA, the country most studied in the recent literature, suggest a decline in the returns to the middle-wage group, and this "decline of the middle class" has led to much discussion among academics and also at political levels. The role of ICT has taken on a potential major role in explaining both the productivity decline as well as "the fall of the middle class" but in two quite different ways. First, was not ICT supposed to be the third major Industrial Revolution and if so, why is its impact on productivity so fleeting?[2] And second, are ICT investments to blame for "job polarization" since ICT replaces routine jobs: bank tellers, middle managers even lawyers whose jobs can be done more cheaply by software programs?[3]

To shed some light on these issues some key concepts are introduced and analyzed below. As well, relative wage and income performance are compared between Canada and the USA and one measure of relative ICT performance between Canada and the USA is examined in some detail.

I then turn to the near future to assess whether ICT's role is over and done. The route of productivity performance is likely always uneven, and with the impact of the great recession still here, I consider that it is impossible to conclude that ICT's role is over. Indeed, I would expect ICT's role principally through smartphones to yield large productivity advances in the future.

9.2 Productivity and Polarization

Wage inequality and rising income inequality are not new topics of the last decade. Simon Kuznets won the Nobel Prize for his studies on income and wage inequality beginning in the 1940s. His 1954 Presidential address to the American Economic Association highlighted growing income *equality* accompanied by rapid increases in per capita income in the USA since the 1920s. In the mid- to late 1970s, income inequality began to rise in the USA and Piketty and Saez (2003) stated "a new industrial revolution has taken place, thereby leading to increasing inequality, and inequality will decline again at some point, as more and more workers benefit from the innovations." Thus, at least initially, the rise of the "digital" revolution was initially thought to increase income inequality but then to decrease it.

The iPhone hit the market only 10 years ago—June 2007, thus we are, in my view, too early in assuming that we know the long-term evolution of this digital revolution.

Technical change does not bring the same rewards to all. Originally economists (Solow 1956) modeled technical change as labor saving. Note crucially that this does not mean that permanent unemployment would result from labor-saving inventions. Quite to the contrary, labor-saving inventions make society better off since the demand for labor is an economy-wide macroeconomic phenomenon. Labor saving devices by making labor more productive increase wages and GNP. The number employed is determined by total demand, exchange rates, exports, and imports, etc. In the shorter run, there are certainly dislocations for that labor that is displaced. Consider agricultural advances in productivity displacing agricultural workers who then migrated to towns in search of employment. We as a society and we as academic economists have done a very poor job in considering the plight of employees severely affected by technological shifts such as the growth of ICT's. We have, as a society, not offered sufficient retraining, guidance, and counseling and the social consequences are clear.

A new hypothesis emerged in the 1990s—that technical change was "skills biased" not just labor saving (Skills Based Technical Change—SBTC) and this change was a result of the rise of microprocessors in the 1980s (see Johnson 1997). David Card and John DiNardo (2002) showed however that SBTC did not explain the patterns of wage inequality of the 1980s and 1990s and that the SBTC hypothesis was inconsistent with other labor market facts such as the returns to education.

In 2003 yet another hypothesis was advanced by economists—that ICT enables the elimination of jobs which are routine based (RBTC). Thus the hypothesis became that middle-class jobs were disappearing because middle-class job functions (bank tellers as an example) were repetitive routine type jobs while high skilled jobs were more "cognitive" and low skilled service jobs were nonroutine. For example, one cannot at this point replace low skilled hospital orderly jobs with ICT. Thus advances in ICT lowered the demand for routine workers, many of whom were in the middle of the income distribution (see Fig. 9.1).

Goos and Manning (2007) show the changes in employment shares by occupation group in the USA for three time periods (1981–1991, 1991–2001, and 2001–2011) and for the three divisions of occupations discussed above—nonroutine manual (low skilled), nonroutine cognitive (high skilled) and the "middle" (routine). In their analysis, the polarization hypothesis appears to be borne out for the USA—routine type jobs have been

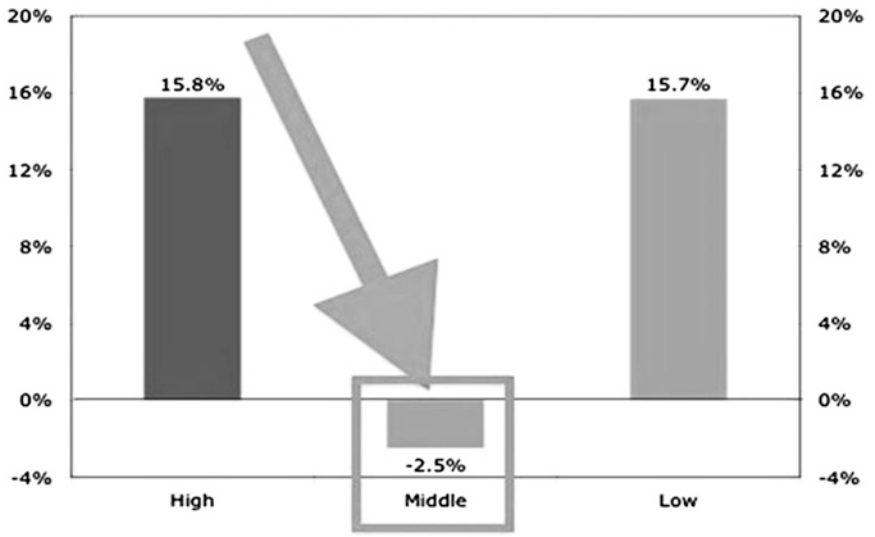


Fig. 9.1 Job growth and decline by skill level in the USA from 2003 to 2013 (*Source* Wells Fargo 2014)

disappearing and at an accelerating rate for three decades. Of course, many other changes have been occurring in the US economy as well over these 30 years, some but not all of these are perhaps affected by the rise in ICT's. One such change has been the rise of outsourcing; a second is the growth of Chinese manufacturing; a third is a move to more of a service-based economy; and a fourth (there are other changes as well) is the new trade agreements (NAFTA, for example).

The rise of China and Chinese manufacturing was based on low skilled Chinese labor (routine biased) migrating to cities from rural areas, like the previous industrial revolutions in England. ICT and global supply chains enabled some of this rise, and the Chinese labor supply replaced routine jobs in the west. But clearly to say that Chinese success is due to ICT (and no one does) is wrong. Nor are new trade agreements "due" to ICT advances. Nor is the rise of the service sector "due" to the rise of ICT; the percentage spent on services rises as incomes grow. Thus, we must be very careful in assessing the role of ICT in labor market changes—a complete general model is needed. It is in my opinion incorrect to make employment analyses at the overall macroeconomic level and to try to assess whether a characterization of jobs is the source of job losses without accounting for the many dynamics and major shifts in the economy. I also doubt that we can credibly assess job and occupational categories as routine, nonroutine,

cognitive, etc. The studies cited above are undertaken at the economy-wide level, and assessing jobs/occupations even at 3 or 4 digit levels omits firm-specific details which are crucial. For example, in the auto sector in the 1980s, assembly line jobs may have been "routine" at many firms but clearly at Toyota they were "routine cognitive."

These caveats are substantial but still the economy wide data do show clear trends in polarization of wage, income, and job classifications especially for the USA. I turn to US–Canada comparisons as Canada is at the same development level as the USA and the two countries share the world's largest open border, language, and culture. Do the two countries share the same employment shifts?

9.3 Canada and the USA

9.3.1 Productivity and ICT

Canada and the USA have many similarities in their economies; many industries even have the same players. Yet Canada has a profile different from the USA in ICT use and in ICT proliferation.

Waverman and Dasgupta (2011) developed "The Connectivity Scorecard" (CS) concept. This scorecard measured and ranked a country's combination of communications infrastructure, usage of this infrastructure, skills and measures of business adaptability of advanced web, and ICT applications and services. For 25 advanced economies, CS utilized 25 different attributes for the three major GNP components: consumers, businesses, and government. Unlike most qualitative scorecards, CS used well-defined weights which were country-specific. Weights were drawn from the economics literature as well as for individual country GNP shares of consumption, business transactions, and government spending. The country that did "best" in any single component received a score of 10 for that component and all other countries were scored relative to that country. Countries were then ranked on their aggregate index, the maximum was 10. In 2011, the last time Waverman and Dasgupta authored the Connectivity Scorecard, Sweden ranked first, the USA second, and Canada eighth.

Below are Venn diagrams from the Connectivity Scorecard calculations for 2011 for the USA and Canada. These diagrams show the three sectors, business, consumers, and government for each country as well as the two components: infrastructure, and usage and skills scores.

Observing the Venn diagram for the USA (9.2a), the USA is the leader among all countries in two categories—consumer usage and skills and in business infrastructure (as the USA position is the farthest out). However, the USA lags the best performing country primarily in two areas—business usage and skills (mainly due to a fall in higher education in STEM areas) as well as in consumer infrastructure (at that time, a lag in broadband relative to the world leaders Japan and Korea).

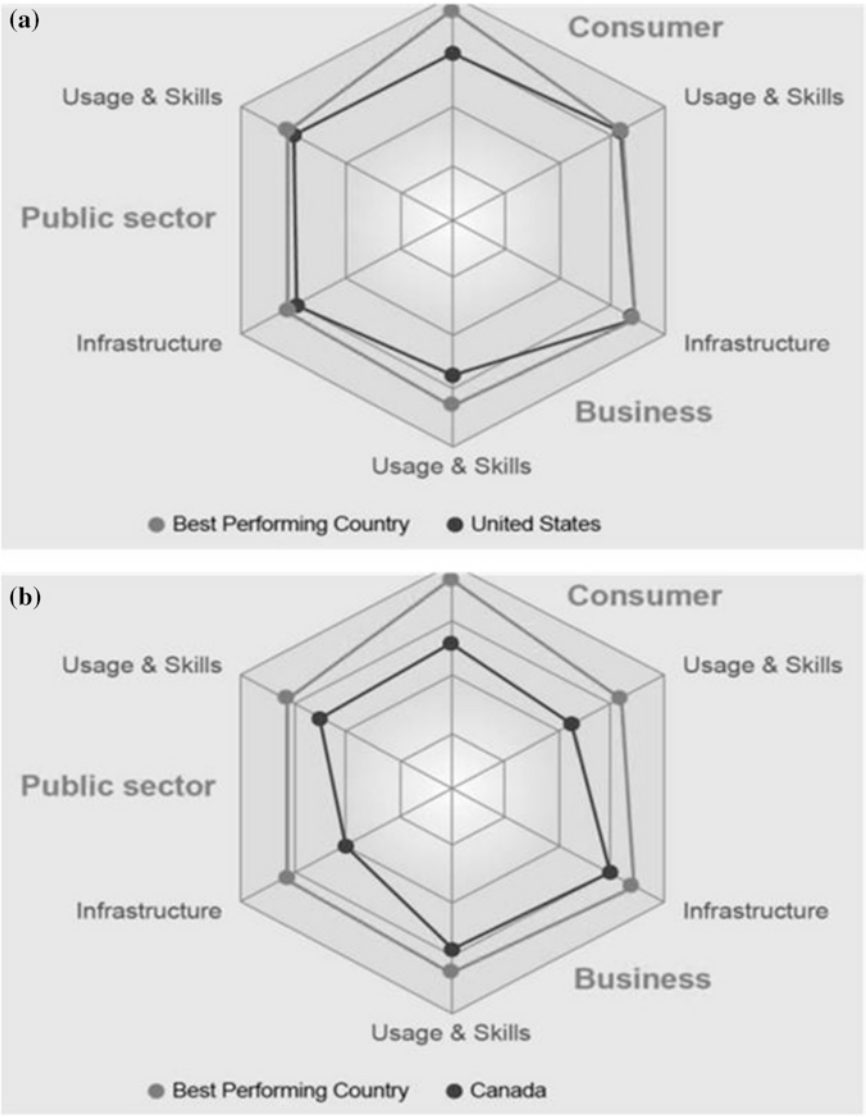


Fig. 9.2 Venn diagrams, connectivity scorecard 2011, USA and Canada

Turning to Fig. (9.2b), the Venn diagram for Canada, the differences with the USA (9.2a) are clear. Even though the two economies have similar styles of business and government, and have the largest bilateral trade in the world, ICT adaption, usage, and skills vary markedly between the two countries.[4] The Venn diagram for Canada is in effect inside that of the USA for five of the six components. Only the category "business usage and skills" is similar for the USA and Canada and the scores for both countries are also among the highest in the world. The differences between Canada and the USA are especially marked for consumer and government infrastructure and for business infrastructure.

Turning to productivity, Canadian productivity growth has consistently lagged that of the USA, as has the contribution to productivity from ICT. Figure 9.3 derived from Fuss and Waverman (2005) disaggregates the 2003 twenty-one percent productivity gap of that year between the USA and Canada into its component sources. We choose 2003 as that was a year when productivity performance in both economies was high and it is also a year when most researchers agree that ICT was a major cause of productivity growth in the USA and elsewhere.

Figure 9.3 is interpreted in the following way. Non-ICT capital differences between Canada and the USA account for only 5% of the 21 point difference between Canadian and USA productivity. Differences in the scale of the two economies (the USA is a much larger country) accounts for 15% of the 21 point productivity difference. Significantly, the lower ICT level in Canada relative to that in the USA accounts for over half of the productivity difference between the two countries!

At the right of Fig. 9.3, the components of this lower level of ICT in Canada are disaggregated. Of the 56% difference explained, only 12% is due to the lower ICT capital stock itself. The majority or 44% is due to what we label the *ICT spillovers or the characteristics of ICT*. A lower level of

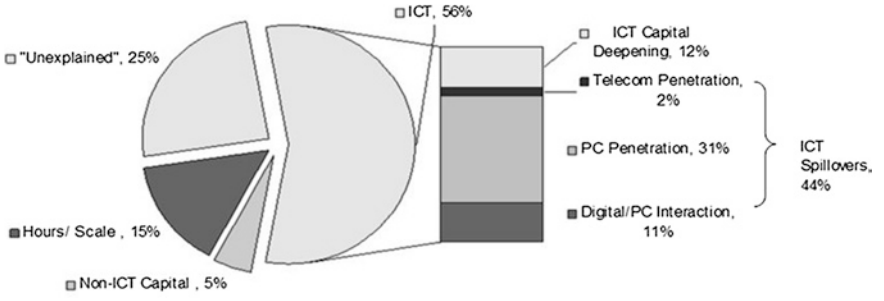


Fig. 9.3 Contributions to US–Canada productivity gap, 2003 (*Source* Fuss and Waverman 2005)

PC penetration in Canada accounts for 30 percentage points of this 56 percentage point difference.

Thus, two very similar economies, geographically next door to each other, with many US subsidiaries being major operating firms in Canada have very different ICT characteristics and performance. Productivity differences are large, ICT levels, usage, and skills differ and explain over half of the productivity differences between the two economies. And these differences persist for decades.

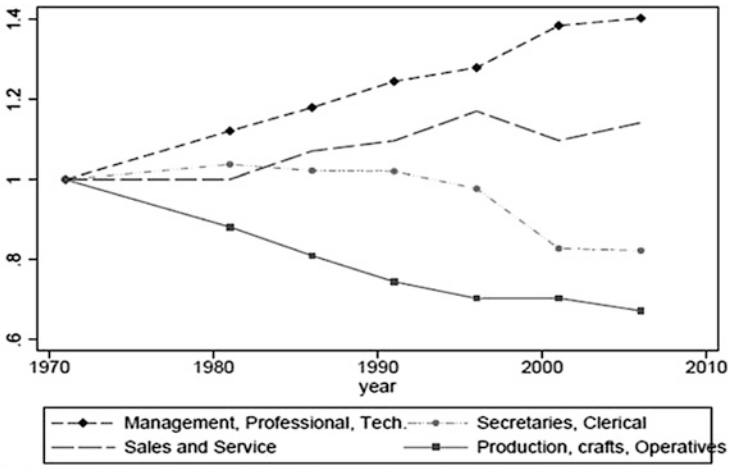
Explaining Canadian poor productivity performance and the role of ICT in that performance is a focus of research in Canada, yet it remains a puzzle.

The polarization of wages/incomes, the major research focus in labor economics in the USA over the past decade is now examined. As noted, aggregate US data show the loss of middle-class/routine jobs. Do Canadian data on employment demonstrate a similar polarization story?

9.4 Income/Wage/Job Polarization: USA and Canada

A number of recent analyses empirically examine the issues of polarization in Canada. I rely on one particular paper here as it examines both USA and Canadian data (Green and Sand 2013). As stated above, comparisons of wage disparities by income class or occupational grouping between two countries are not easy to make because of a variety of issues. There is also a lack of comparability of data. Issues of institutional governance also affect comparisons, as I now show.

Canada has a more progressive tax and welfare system than does the USA; Canada has a well-functioning universal health-care system; the US health-care system is privately funded except for the new provisions of Obamacare. Should we be examining before tax income or after tax and after entitlement income? Should medical care be included as this is funded in Canada through payroll deductions and taxes? So, the issues of before tax or after tax income, and income before or after entitlements such as welfare or medical care payments are important components in the issue. Countries with more progressive tax and welfare schemes will have less polarization in after tax income than in before tax wage income.



Data comes from the Canadian Census Master Files from 1971-2006. The figure represents the share of hours worked among four broad occupation classifications, indexed to 1 in 1971.

Fig. 9.4 Canada: Share of hours worked 1970–2010 (*Source* Green and Sand 2013)

We begin with data on employment. Figure 9.4 presents a general picture of employment trends across occupations in Canada from Green and Sands (2013). The data show Canadian employment distribution (hours worked) among four classifications: management, professional, technical; sales and service; secretarial, clerical; production, crafts and operatives for the 1970–2010 period. The latter two job classifications are more likely to be routine-based jobs. Normalizing at 1 for all four job categories in 1971, one can see relative growth in the first category, managerial, professional, and technical. For the second category, sales and service employment, its share of all employment rose from 1980 but falls from 1995 to 2000 and then increases again.

The crafts and operatives category share has been in decline since 1971 with a leveling out in the 1995–2000 period and a decline again post 2000. The category secretaries and clerical share of employment rose slightly to 1980 fell slightly to 1990 then fell to 2000 especially in the 1995–2000 period.

The US data in Fig. 9.5 show similar but more pronounced movements particularly in the post-2000 period.

Green and Sand (2013) summarize their results for Canada for this period as follows:

> *We find that there has been faster growth in employment in both high and low paying occupations than those in the middle since 1981. However, up to 2005, the wage pattern rejects a simple increase in inequality with greater growth in high*

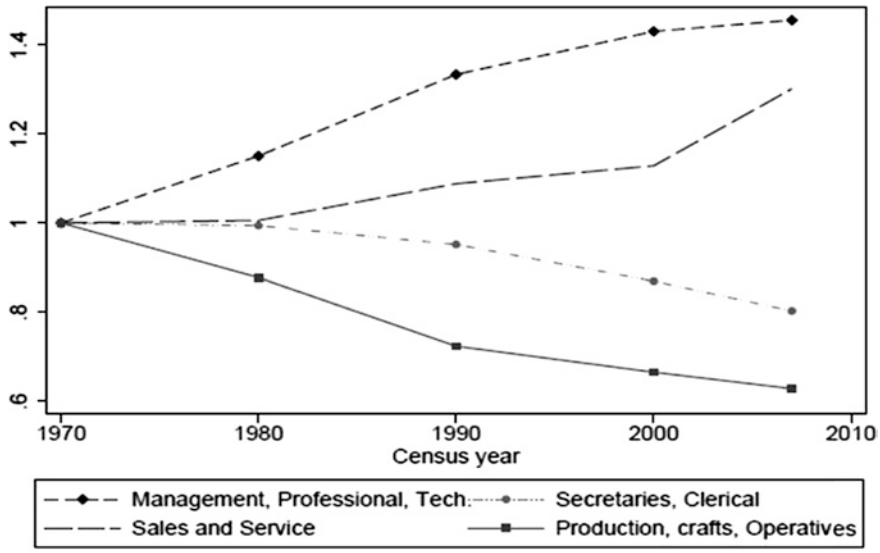


Fig. 9.5 USA: Share of hours worked 1970–2010 (*Source* Green and Sand 2013)

> *paid than middle paid occupations and greater growth in middle than low paid occupations. Since 2005, there has been some polarization but this is present only in some parts of the country and seems to be related more to the resource boom than technological change. We present results for the US to provide a benchmark. The Canadian patterns fit with those in the US and other countries apart from the 1990s when the US undergoes wage polarization not seen elsewhere.* ***We argue that the Canadian data do not fit with the standard technological change model of polarization developed for the U.S.*** (emphasis added)

Green and Sand also state:

> *In a study that compares movements in both employment and wages between the U.S. and Germany, Antonczyk, DeLeire, and Fitzenberger (2010) find that, although there are similarities in occupational employment between the two countries that is consistent with technological change, the differences in the evolution of the wage distribution between the two countries is so large that technology alone cannot explain the wage trends.*

We turn to another comparison for the USA and Canada, examining wage movements rather than occupational shares. Figures 9.6 and 9.7 reproduce data from Green and Sand (2013) on the percentage change in weekly wages (e.g., change in weekly wages by wage percentile 1991–2001) for Canadian men (Fig. 9.6) and for US men (Fig. 9.7). The "hollowing out" hypothesis is that wage changes in the middle of the distribution are negative.

Fig. 9.6 Change in log weekly wages by percentile change from 1991 to 2001 (*Source* Green and Sand 2013, pp. 12 and 13)

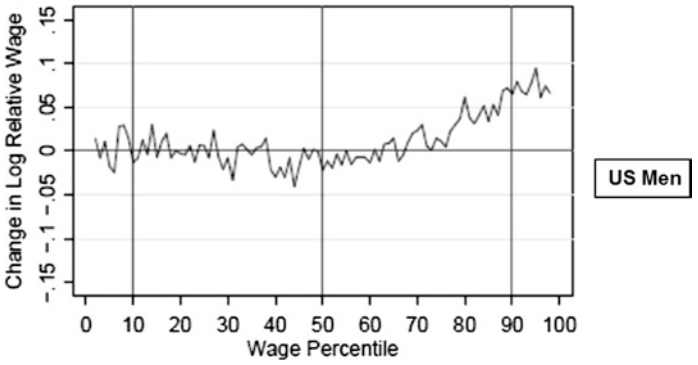


Fig. 9.7 Change in log weekly wages by percentile change from 1990 to 2000 (*Source* Green and Sand 2013, pp. 12 and 13)

For Canada (Fig. 9.6), in the 1990s, to summarize, median wages show a near-ubiquitous increase in wage inequality over the entire range. There are wage decreases below the 40th wage percentile and increases above that level, *but there appears to be no "polarization"*—wages in the middle segment did not fall relative to higher or lower wages.

The US wage data pattern in the 1990s (see Fig. 9.7) is markedly different from these Canadian data (and from most European patterns as well). In the USA, the pattern is not linear, but there are modest wage increases up to the 30th wage percentile, modest decreases to the 70th percentile (polarization?) and increases thereafter.

For the period 2001–2006, the wage patterns are as follows for Canada and the USA:

When we examine the data for 2001–2006, very different patterns emerge for Canada and the USA. For this more recent period, Canadian wages (Fig. 9.8) show little change up to the 70th percentile while wages grew 5% for the higher wage group. For the USA (Fig. 9.9), wages below the 25th or so percentile fell and wages above the 55th percentile grew and rapidly, by 10–15% for the top 90th percentile. Between the 25th and 55th percentile, US wage rates appear to have been relatively stagnant.

To summarize this brief survey of one paper comparing USA and Canadian occupational share and wage rate data, US aggregate data do show job classification shifts away from "routine" jobs; Canadian data appear to not show such shifts. Examining percentage changes in wage data, some hollowing out of the "middle class" is evident in the USA. No such pattern

Fig. 9.8 Change in log weekly wages by percentile change from 2001 to 2006

Fig. 9.9 Change in log weekly wages by percentile change from 2000 to 2007 (*Source* Green and Sand 2013)

is seen in Canada. And these data are for pretax percentile wage distribution data. On an after tax basis, wage polarization would not appear to typify aggregate Canadian data 1991–2006.

9.5 Relation to ICT?

We saw earlier that Canada lags the USA in many types of ICT infrastructure, adaption, applications, and usage. The largest gaps in 2011 were the lower levels in Canada in ICT business, government and consumer infrastructure, as well as in Canadian consumer usage of ICT.

We saw earlier that business ICT usage and skills are very similar in Canada and the USA. So, the poorer Canadian productivity performance cannot be because of this. And it is hard to see how the differences that do exist between Canada and the USA in ICT—in consumer and government infrastructure could have large productivity impacts as productivity is largely a business phenomenon. The data in Fuss and Waverman (2005) do show a significant lower adaption of computers in Canada—these differences are suspicious and could be due to data errors but if these are true differences, this one ICT capital stock difference would be a significant factor.

Of course, the widely reported and discussed fall in worldwide productivity since 2007, particularly in the USA is both perplexing and troubling. Figure 9.10 shows the productivity experience in the USA since 1947. Until 1972, productivity growth in the USA was at very high levels, some 2.8% per year. As Robert Gordon stresses, this postwar period saw many technological advances as well as the postwar recovery period. From 1973 through 1995, productivity growth in the USA (and in most of the world) was tepid, averaging just above 1.5% per year. Policy makers, analysts, and economists bemoaned the stagnation of productivity growth over this 20 year period. The period 1995–2007 is clearly well above the productivity performance of the period from 1973 to 1990. Most researchers cited ICT developments as the reason for this growth spurt.

> *… the underlying cause was an increase in the rate of decrease of semiconductor prices and, in turn, of ICT capital equipment. In response to falling ICT prices, producers in both services producing and goods-producing sectors shifted increasing amounts of capital investment toward ICT products, reducing in some cases purchases of more traditional capital equipment. Subsequently, many business analysts have noted that, following a gestation lag, the lower cost of ICT equipment has induced firms to "make everything digital" and reorganize their business practices* (Anderson and Kliesen 2006)

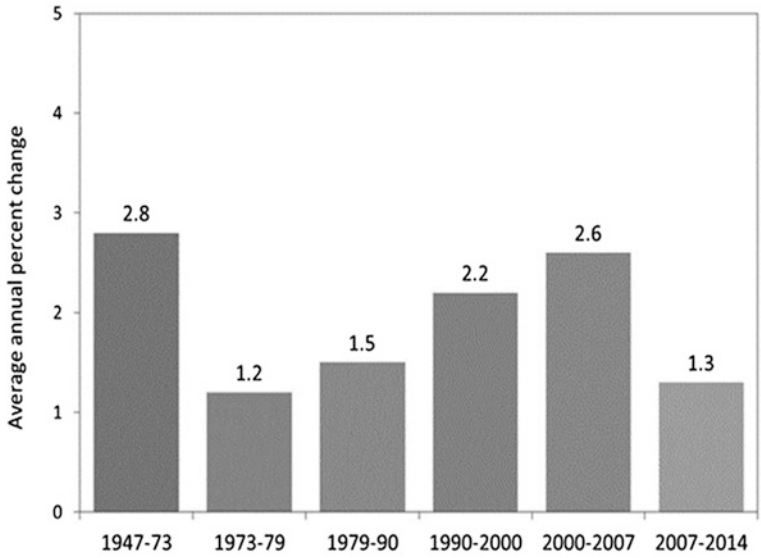


Fig. 9.10 Productivity change in the US nonfarm business sector, 1947–2014 (*Source* US Bureau of Labor Statistics)

Note the fall off in productivity growth since 2007, through 2014, rising at only 1.3% per year—are we back to the future—the relatively low growth of 1973–1995, is that the new normal? This is what Robert Gordon argues in his new book (2016). Professor Gordon argues that ICT developments are not of the same order of magnitude, longevity or "general purpose" as steam or the internal combustion engine or other products that have had long-term significant productivity boosting impacts.

However, I think that "it's too early to tell," that we as yet do not know whether we are back to the tepid productivity growth of 1973–1995.

Remember that the World Wide Web dates to 1996, 21 years ago. We are thus not far down the ICT path. Nor can we expect monotonic improvements in welfare and productivity given economic shifts unrelated to ICT such as the Great Recession of 2008, the dislocations of which are still being felt worldwide.

The explosion of social media, viral networks and applications spawned in 2007 by the iPhone are now but ten years old! Most advances have been directed at the consumer market. Even there, new advances such as self-driving cars and virtual reality are not market ready. *We have not yet begun to tap the enormous business potential of the ubiquitous smart phone*. It is critical to remember that other general purpose inventions were slow to come to

fruition and uneven in timing and impact. "…steam had a relatively small and long-delayed impact on productivity growth…" (Crafts 2002). In a well-cited paper, Paul David (1989) states "…the transformation of industrial processes by the new electric power technology was a long delayed and far from automatic business."

Thus my conclusion, "it's too early to tell."

Productivity will improve as the ICT revolution continues to expand beyond consumer-driven social media. Certainly the US data do appear to show that ICT is, at least, in the short to medium term a source of growing income disparity because of the displacement of "routine" jobs. In the steam era, the displacement of agricultural workers due to mechanization in agriculture increased the labor force needed for the new factories. Today, the displacement of routine noncognitive jobs by ICT has not led to a parallel expansion of employment in jobs spawned elsewhere by ICT. That is, the adjustments for routine labor jobs in earlier technological shifts were in essence self-reinforcing. The farmer was displaced, costly moves were required to migrate vast distances to jobs in urban metropolises. No one wants to minimize these costs. However, today the skill levels required are to move from routine-based jobs to nonroutine or cognitive occupations. These are very different transitions from the past. Rich countries—the West—have done far too little to enable such job/occupational shifts. And for those who cannot at their life cycle stage make such adjustments, we have not created the needed social safety nets. All countries need to look at the US experience. And we need to prepare for these coming changes by identifying at risk groups and preparing counseling, training and income relief far better than we have in the past.

Notes

1. The potential measures of income inequality used in the literature are many, and can be measured as inequality of total income, inequality of income with or without capital gains and dividends, inequality of wage income, inequality of wealth, etc. The ways to measure income (or wage) inequality are also many, and include: the percentage of total country income earned by the top x%, usually the top 10% or 1%; the Gini Coefficient measuring deviations from equal income distribution; and now the "polarization" effect: comparing wage changes over time for certain classes of wage earners, generally "low," "middle" (the middle class), and "high."
2. Gordon, Robert (2016), *The Rise and Fall of American Growth* (Princeton: Princeton University Press).

3. Note that these two concerns about ICT are in essence mutually exclusive since if ICT does remove many jobs, then productivity (which is measured as output change minus capital and labor force changes) should be growing.
4. See Alan Blinder on the productivity slowdown in the USA, Wall Street Journal May 14, 2015. Some authors pick 2005 as the date of the slowdown, some 2007 and some 2010! In part 5 I show data for pre- and post-2007 productivity growth.

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